

The examiner acknowledges that Papa does not teach the use of a membrane separation unit to remove water and ethanol.

Papa is directed to an improved esterification process wherein the improvement comprises use of a specialty catalyst, specifically, a long alkyl chain benzene sulfonic acid catalyst for removal of acidic sulfates produced in the esterification process. (see col 1, l 5-10). Column 2, lines 10-20 further describe the Papa invention and object and teach further on the catalyst employed. Column 2, lines 45-51, as noted by the examiner, merely quote the esterification process steps. However, column 2, lines 52-64 go into detail on the esterification catalyst and note that the improvement in the esterification process is the use of the specialty catalyst described.

Applicants are not claiming esterification per se. The present invention claims an improvement on the esterification process wherein a portion of the organic phase formed in the esterification process from the first distillation is directed to the reaction zone. Another claim recites the organic phase being directed to a membrane separation unit, which removes the water from the organic phase in the ethyl acetate. The present claims are all Jepsom format claims and recite "an improvement" over the art. Nowhere in Papa is the improvement claimed herein disclosed or suggested.

To form a water-ester azeotrope from an esterification reaction, it is necessary to have the proper ratio to enable the separation. Typically, the esterification reaction alone does not provide the proper ratio and it is necessary to add something to the reaction mixture. In the case of production of ethyl acetate, one must put back ester. Applicants have found it preferred to use ester that is as dry as possible to achieve the proper ratio for azeotroping the mixture of water and ester, and remove the water. The present invention returns (essentially dry) ester to the reaction zone. It is not obvious to return or use dry ester to achieve this azeotroping. A distinction between Papa and the present invention is that the reaction stream in Papa is not dry, and has several % of water content, hence is forwarded to a distillation column for removal of water before return to the reactor. Figure 1 of Papa illustrates combining acid, alcohol and catalyst in the reactor 5, the mixture is forwarded to a distillation column 4 wherein a portion is directed to a decanter for separation into organic and aqueous phases. A portion of the organic phase is forwarded to a refining still 11, and a portion to the distillation column 4 for drying before it is recycled to the reactor. Papa does not directly forward at least a portion of the organic phase to the reaction zone as claimed in the present invention.

An alternate invention as claimed is the forwarding of the organic phase to a separation membrane. Papa does not disclose or suggest doing anything special to the organic phase to lead one of skill in the art to process it through a membrane unit.

With regards to Spiske, it is stated in the action that Spiske discloses a process for removing water from the reaction mixture obtained from the preparation of carboxylic esters by the reaction of alcohols and carboxylic acids in the presence of an acidic catalyst (see col 1, lines 43-48). The Examiner states that "if a person having ordinary skill in the art had desired to improve the phase separation by means of the membrane separation unit during esterification, it would have been obvious [to] have used Spiske's membrane separation unit in the Papa esterification process, thereby facilitating the removal of water in the process as well as reducing the cost of the operation." This is respectfully traversed.

Spiske is directed to removal of water from a mixture of alcohols and/or carboxylic acids and/or esters by pervaporation or vapor permeation. (col 1, lines 7-10). Column 1, lines 34-42 describes the object achieved by bringing the esterification reaction mixture into contact with one side of a membrane and removing the water containing permeate in vapor form from the other side of the membrane, which comprises using a membrane obtained by plasma polymerization. It is essential for the Spiske process that the pervaporation be prepared by plasma polymerization. (see col 3, l 14). A review of the Figure of Spiske reveals that the entire reaction mixture is subjected to the plasma polymerization prepared pervaporation membrane unit. In Spiske, the alcohol and acid are premixed in vessel 1, the mixture is directed to vessel 2 (the reactor), the residue of vessel 2 goes through a pump and is forwarded to the membrane separation unit, where an organic phase (ester and unreacted alcohol or acid) and an aqueous phase are formed and further processed. The ester product is removed (as line 8) and a recycle stream 10 containing the unconverted alcohol and/or acid is returned to the reactor vessel 2. (see col 2, l 61 – col 3, l 7).

The organic phase of Spiske is not singularly flushed through the membrane described. Nowhere is this disclosed or suggested. Spiske takes the entire reaction product, which contains high amounts of water, through the membrane separation unit. The present invention claims an esterification process wherein a portion of the organic phase is directed to a membrane separation unit to remove the water from the ethyl acetate rich organic stream. Unlike Spiske, the invention first separates the organic and aqueous phase and at least a portion of the organic phase is subjected to a membrane separation unit.

A combination of Papa and Spiske still does not achieve the invention as claimed. To combine would result in the entire reaction mixture of Papa going through a membrane separation unit of Spiske. There is nothing in either reference to suggest placing just the

organic phase through a membrane unit. Likewise, there is nothing in either reference to suggest returning at least a portion of the organic phase to the reaction zone (without first undergoing further distillation).

It is important to look at the process as a whole. The specific organic stream selected by Applicants was just a choice the skilled man could have with no particular reason why he would have selected this stream. Papa and Spiske do not teach or suggest the processing of the organic phase as claimed.

The prior art has been considered and is believed relevant as merely background information, but does not disclose or suggest the invention as claimed.

CONCLUSION

It is respectfully submitted that the Examiner has not established by applied prior art how any of the claims are obvious and thus not patentable. It has not been established how one of ordinary skill in the art would have applied Papa and Spiske to arrive at the subject invention.

Applicants invite the Examiner to contact the undersigned attorney by telephone if there are any matters or issues outstanding that have not been addressed to the Examiner's satisfaction.

Respectfully Submitted,

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